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EVALUATION OF SPRING-APPLIED BASAMID TO CONTROL SOIL-BORNE ROOT PATHOGENS AT LUCKY PEAK NURSERY, IDAHO

by
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ABSTRACT

Populations of three genera of potential conifer seedling root pathogens Fusarium spp., Pythium spp., and Rhizoctonia spp. were monitored prior to and following fumigation. While post-fumigation population levels of all three fungi were reduced initially, Fusarium spp. populations resurged to levels comparable to control plots within 2 months. Comparison of population differences of all three fungi by field location was noteworthy.

INTRODUCTION

Fumigation of nursery soils to reduce pest populations to tolerable levels is a standard management practice at many forest nurseries in the United States (Abrahamson 1985). Target pests are primarily plant pathogens, nematodes, weeds, and insects.

For the past 10 years, the USDA Forest Service Lucky Peak Nursery located near Boise, Idaho, has fumigated nursery beds with Dowfume MC-33 (33 percent methyl bromide, 67 percent chloropicrin). While effective in reducing populations of Fusarium spp. at the Lucky Peak Nursery (Marshall 1983, 1985), the material is very toxic to humans, requiring extreme precautions during application. Use of the material is currently being scrutinized in the United States. Thus, out of concern for health and safety, and mindful that the specialized handling of the material and tarping of treated areas is increasingly expensive, managers at the USDA Forest Service Lucky Peak Nursery decided to field test alternative fumigants.

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EXPERIMENT STATION

Several alternative soil fumigants have been considered. Marshall (1986) evaluated efficacy of Telone C-17 (dichloropropene) with and without tarping. He found the material to effectively reduce populations of Fusarium spp. with a concomitant increase in populations of Trichoderma spp.

Another material of interest, Basamid, also known as Mylone or Dazomet, (Tetrahydro-3,5-dimethyl-2H-thiadiazine-2-thione) is reportedly effective in controlling weeds, nematodes, and soil-borne fungal pathogens. The material has been tested at several western nurseries (Tanaka et al. 1986) where it has been found to be nearly as effective as methyl bromide/chloropicrin in reducing populations of Fusarium spp. and Pythium spp. while improving seedling quality and other characteristics. Use of Basamid compared to methyl bromide/chloropicrin has several distinct advantages--being a granular material it can be broadcast applied, tarping is unnecessary, and the material can be applied the year of planting to only those areas to be sown.

In 1987, efficacy of Basamid for reducing pest populations was tested at the Lucky Peak Nursery. To do this, pre- and post-fumigation assays of potentially pathogenic fungi and nematodes in treated and untreated areas were made.

METHODS

General Sampling Design

The Lucky Peak Forest Nursery is divided into 14 fields. Each is subdivided into an average of 16 compartments. Compartments are 30 feet wide and about 400 feet long. Four compartments, two in field 5 and two in field 9, were selected for the Basamid evaluation. To eliminate edge effect of roadways, a 20-foot area at both ends of each compartment was eliminated from consideration. The remaining footage of each of the four compartments was subdivided into 60-foot-long units. One treatment unit and one control unit were randomly selected for sampling from all possible units in each field.

In each sampling unit, soil samples were collected from five sample points. These points were randomly selected from 10 possible points spaced 6 feet apart on a centrally located 2- by 5-point grid. The grid was 6 feet wide by 24 feet long and was oriented parallel to the long axis of the compartment.

At each sample point, five soil cores were extracted with a standard 1-inch-diameter soil probe from the upper 6 inches of the soil profile. One core was taken at point center with the others being taken 12 inches away in each cardinal direction. The five cores from each sample point were combined in a labeled plastic bag and immediately placed in a cooler for transport.

Sampling Schedule

The two treated and two untreated units were each sampled three times during 1987: pre-treatment samples were collected April 15 the day prior to fumigation; initial post-treatment samples were collected on May 1; and a second set of post-treatment samples was collected on June 23.

Identification and Diagnosis

Soil samples were shipped in coolers to the Peninsu-Lab pest and disease diagnostic service in Kingston, Washington, for soil pathogen assay. For the pre-treatment samples, populations of potentially pathogenic fungi including Fusarium spp., Pythium spp., Rhizoctonia spp., Phytophthora spp., and Macrophomina spp., as well as populations of plant pathogenic nematodes, were assayed using established standard procedures (Komada 1975, Johnson and Curl 1972, Hendrix and Kuhlman 1965). Assays were made for only Fusarium spp., Rhizoctonia spp., and Pythium spp. for the post-treatment assays.

RESULTS AND DISCUSSION

Macrophomina spp., Phytophthora spp., and plant pathogenic nematodes were not detected in the pre-treatment soil samples; thus, analyses for them were not made in subsequent samples. Rhizoctonia spp., Fusarium spp., and Pythium spp. were detected--only presence or absence of Rhizoctonia spp. was determined; whereas, populations of Fusarium spp. and Pythium spp. were quantified in propagules per gram (ppg) of soil. Information for the organisms detected is shown in Table 1.

Pre-treatment populations of the three organisms varied by field. In field 9, populations of Fusarium spp. were 200-500 ppg of soil. These levels are comparable to those detected from previous evaluations at the Lucky Peak Nursery (Marshall 1986) but are considerably lower than those found at other western nurseries (Tkacz 1983, Norris 1983, James 1984). In field 5, populations of Fusarium spp. were very low--about 10 ppg of soil. Likewise, Pythium spp. populations were higher in field 9 than in field 5, averaging about 120 ppg and 50 ppg, respectively. Rhizoctonia spp. were consistently detected in both fields.

Effects of Basamid on target organisms also varied by field. Compared to populations in untreated units and the pre-treatment samples, fumigation appeared to be generally effective in reducing populations of the three genera of fungi at the initial post-treatment sampling period in May. None of the three genera of fungi were detected in the field 5 treated unit. In the field 9 treatment unit, low populations of all three genera remained, particularly at two specific sample points where all were present. In one of these two samples, an almost two-fold increase of Fusarium spp. was detected. Perhaps these samples included heavy clay clods that had not been penetrated by the fumigant, or the fumigant was poorly incorporated at the specific sites. Hildebrand and Dinkel (1988) speculated that post-treatment population increases at specific sample points in their evaluation of Basamid were a result of reinvasion by wind-blown propagules.

Table 1. Population of three soil-borne fungi isolated from treated and untreated units in two fields at the Lucky Peak Nursery, Idaho, 1987

	FIELD 5									FIELD 9								
	Fusarium			Rhizoct.			Pythium			Fusarium			Rhizoct.			Pythium		
Sample #	A[1/]	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1. Control	80	30	120	+	+	+	60	10	0	140	440	1370	+	+	+	90	210	150
2. Control	0	0	0	+	+	+	50	10	0	330	320	980	+	+	+	110	290	30
3. Control	0	20	570	+	+	+	50	10	10	220	170	920	+	+	+	130	130	170
4. Control	0	0	20	-	-	-	50	10	0	200	20	920	+	+	+	80	50	190
5. Control	0	20	10	+	+	+	40	0	10	190	20	1220	+	+	+	110	70	160
$\bar{X}$	16	14	144	.8	.8	.8	50	8	4	216	194	1082	1	1	1	104	150	140

	FIELD 5									FIELD 9								
	Fusarium			Rhizoct.			Pythium			Fusarium			Rhizoct.			Pythium		
Sample #	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
6. Basamid	0	0	20	-	-	-	30	0	0	480	780	270	+	+	-	140	20	40
7. Basamid	0	0	0	+	-	-	30	0	0	350	10	610	+	-	-	120	0	100
8. Basamid	10	0	0	+	-	-	50	0	0	230	20	230	+	-	-	150	0	20
9. Basamid	0	0	0	+	-	-	80	0	0	370	20	3200	+	-	-	140	0	50
10.Basamid	30	0	20	+	-	-	60	0	0	540	110	720	+	+	-	120	40	150
$\bar{X}$	8	0	8	.8	0	0	50	0	0	394	188	1006	1	.4	0	134	12	72

[1/] Sampling dates: A = April 15, 1987; B = May 1, 1987; and C = June 23, 1987
Fumigation date: April 16, 1987.

At the second post-treatment sampling period in June, Rhizoctonia spp. were not detected in treated units in either field, while incidence in untreated units in both fields remained high. In field 5, Pythium spp. populations remained undetectable in the treated unit and continued to decline in the untreated unit; populations in the field 9 untreated unit remained static but increased to half the pre-treatment levels in the treatment unit. Populations of Fusarium spp. increased to levels comparable to or exceeding pre-treatment levels in both treated and untreated units. In field 9, Fusarium populations in the untreated and treated units were similar at about 1,000 ppg of soil; while in field 5, populations averaged 144 and 8 ppg of soil in untreated and treated units, respectively.

According to Hildebrand and Dinkel (1988), damping off may occur when Fusarium populations exceed 1,000 ppg of soil. Little damping off was noted; however, such damage thresholds often vary by host species and climatic and edaphic conditions.

The early summer resurgence in populations of Fusarium spp. in both treated and untreated units in both fields noted in this evaluation is counter to population dynamics identified for several Washington State nurseries (Tanaka et al. 1986). At these nurseries, populations in untreated nursery soils peaked in March and declined to very low levels, similar to those in treated areas in June and July; in treated units, populations were very low throughout the spring and summer and remained so into the following year.

Populations of Pythium spp. developed differently in the two fields. In the field 5 untreated unit, populations declined to very low levels at the May sampling period and even further, to an average of 4 ppg, at the June sampling period. In the field 9 untreated unit, a 50 percent increase, to an average of 150 ppg, was detected at the May sample period and remained at that level at the June sample period. The timing of population increases in field 9 was similar to increases noted in the Washington study where peak populations were detected in late April and early May.

It is obvious that at the Lucky Peak Nursery populations of soil-borne pathogens sampled varies considerably in both temporal and spatial aspects. Likely, a great deal of this variation is due to variation in soil type, compartment cropping, and treatment history. It appears also that at the Lucky Peak Nursery efficacy of Basamid in reducing soil-borne populations of potential pathogens varies considerably--Basamid was effective in reducing populations of these organisms totally in some areas; while in other locations fungi were reduced to low population levels for only several months when a resurgence occurred.

Whether treatment was unnecessary in Field 5 or the short-term depression in populations in Field 9 was effective in reducing disease severity can only be determined by comparing numbers of plantable seedlings in treated and untreated areas in each field. That information will be collected and evaluated at the end of the 2-0 year.

Regardless of the effects of Basamid on populations of potential soil-borne pathogens, the question of threshold numbers of pathogen propagules and conditions required for disease development and expression to take place for the various species of conifer seedlings grown remains. In some situations, very low populations may cause high disease levels, and in others the opposite may be true. The question can only be answered by precisely characterizing the soil growing medium and any additives (water, nutrients, or pesticides) and closely monitoring edaphic/climatic conditions, seedling, populations of potential pathogens and beneficial organisms, and any associated disease development. Thus, the information gathered from this study is only one piece to the puzzle; further information must be obtained to complete the picture.

RECOMMENDATIONS

Comparative pre-fumigation Fusarium spp. counts at Lucky Peak Nursery are much lower, especially in previously fumigated beds, than at other Forest nurseries. As pathogenicity tests or mortality determinations were not conducted in this study, it is difficult to infer whether Fusarium spp. are a problem at the nursery or whether the reported counts are part of the normal micro-floral background that infests soil by means of rain or irrigation water, dust, and soil carried by people or their equipment (Vaartaja 1967). Although the population of Fusarium spp. appeared unaffected by Basamid application (at least over the total sampling period in field 9), the chemical was effective in reducing Pythium and Rhizoctonia population levels. Moreover, the fumigant has proven effectiveness in other areas (Tanaka et al. 1986). Therefore, until seedling mortality associations can be determined, we continue to support continued use of Basamid in lieu of methyl bromide/chloropicrin.

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